INVESTMENT IN A SUSTAINABLE FUTURE : TARGETING INCLUSIVE HUMAN DEVELOPMENT WITH FISCAL ALLOCATION IN EDUCATION IN SOUTH-ASIA

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Abstract

We examine the impact of public expenditure on education on human development measured by the United Nations Development Programme (UNDP) Human Development Index (HDI) in South Asia. Using country-level data for 32 years from 1991 to 2022 on ten South Asian nations, we estimate fixed effect panel data regression. We find that a 1 percentage point increase in government expenditure in education– measured as a % of GDP– is associated with a 0.01515 increase in HDI for the ten countries during the study period. Considering HDI on a scale from 0 to 1, this is indeed substantial. Additionally, we find a statistically significant and positive association between the number of primary and secondary educators and higher HDI scores. This positive association is also found for training of teachers. Results are stronger for primary level in case of number of teachers. In secondary level, results are stronger for training of teachers. Although the literature explores the topic in detail, empirical evidence in South Asia, particularly for Bangladesh, is inadequate. We believe our findings will inform better fiscal resource allocation in education in Bangladesh.

Keywords : *Education, Economic Development, Human Development Index, National Government Expenditures, Education Expenditure, Primary Education, Secondary Education, Fixed Effects Models*

JEL Classification : *I25, O15, H52, C23*

1. INTRODUCTION

If we divide the 1991 global gross domestic product (GDP) by the total population of the world at the time, we arrive at a per capita GDP figure of $6,783.9 (in constant 2015 USD terms). After 32 years, that number rises to $11,318.7 in 2022. While this near doubling of global per capita GDP in three decades deserves celebration, it begs the question: has there actually been a near doubling of human welfare as well?

If ‘development’ is about engendering greater ‘freedoms’ for human beings, as eloquently argued by Sen (2001), people and their wellbeing should be the goal.

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Admittedly, for the most part of the twentieth century, aggregate measures of output i.e., GDP, have been considered synonymous to human development– leaving behind the multitude of considerations embedded in identifying and measuring welfare (Costanza et al., 2009; Costanza et al., 2016).

By 1980s, large scale environmental degradation, severe disturbance of fragile ecological balances, and the rise in asymmetric distribution of wealth around the world were deeply concerning. The last three decades have seen broader recognition of the importance of a sustainable development paradigm (Farrell & Hart, 1998; Sneddon et al., 2006). The 1992 Earth Summit in Rio de Janeiro cemented worldwide commitment towards a sustainable development vision: the following decades went through a continuous– albeit circuitous– path to understanding, measuring, and investigating sustainability, and finding economic and technological solutions for a sustainable future (Sneddon et al., 2006).

Education plays a defining role in all economic and social outcomes. Our understanding of education's impact has evolved gradually, with a concurrent transformation of how education– as a function and as an instrument– is conceived. From no consideration in classical economic thinking, to conception of 'human capital' formation, onto Education for Sustainable Development (ESD), and most recently, with observance of the Decade of Education for Sustainable Development (DESD), our understanding of education in key policy outcomes has been enriched (Kopnina & Meijers, 2014; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2014).

Currently, from a policy standpoint, there are two obstacles to the undertaking of sustainable development. First, how do we measure human development? As one New York Times article from 2010 aptly put it: challenges to the GDP as a measure of progress are emerging "not from a single new index, or even a dozen new measures, but from several hundred new measures" (Gertner, 2010).

Second, timely and resolute policy decisions are hindered by a lack of understanding of how sustainable development outcomes are affected by economic and societal systems. Irresolution in mobilizing resources to education, for example, cannot be afforded, given the narrow time window within which the world has to act before irreversible damage to ecosystems is done and difficult-to-mitigate societal crises arrive. Emerging economies with large, young populations, like Bangladesh, face unprecedented upcoming economic, climate, and geopolitical challenges (Calvin et al., 2012; Delaporte & Maurel, 2018).

In Bangladesh, the debate over allocation priorities is being shaped slowly (see Chowdhury and Sarkar (2018) for an overview). How much should education, along with healthcare, social security, and climate resilience, receive from limited fiscal resources?

By any means, however, this is not a Bangladesh-only problem. But the decision dilemma is endemic to most emerging nations, specially those in the South Asia region. The aforementioned lack of empirical evidence on the nature of impact education has on quantifiable human development outcomes further complicates the policy space. In this paper, we elucidate resource allocation conversation by providing robust statistical evidence on education's positive and significant impact on human development, as measured by the Human Development Index (HDI).

We model data from 1991-2022 for ten countries with similar economic and societal realities from the South Asia region. Figure 1 provides a big-picture overview of the relationship between government expenditure on education, expressed as a percentage of GDP, and HDI scores for ten South Asian countries during 1991-2022. The horizontal axis represents country-specific annual HDI scores. The vertical axis denotes expenditure on education. The size of each dot denotes GDP per capita. In essence, the plot captures our core empirical finding: higher allocation to education is associated with higher scores in HDI. We note the distinct positive trend upwards in the scatterplot, which gives away the positive association. It is evident that productivity and human development are associated positively as well; higher HDI observations and higher GDP per capita observations concentrate in the upper right corner of the plot.

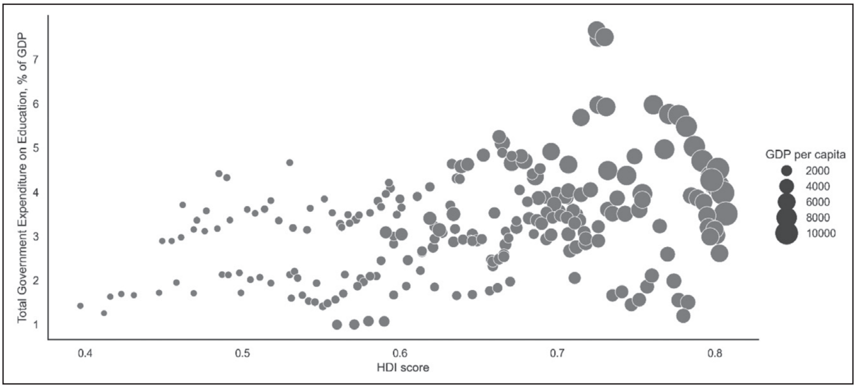

Figure 1 : Scatter plot of HDI Scores and Expenditure on Education (Size denotes per capita GDP in 2015 constant USD)

Source : Plotted by the authors using World Bank and UNDP data

In this paper, we show that a 1 percentage point increase in government expenditure in education– measured as a % of GDP– is associated with 0.01515 increase in HDI. This is significant given that HDI is on a scale from 0 to 1. We also show that prioritizing the education system in terms of the number of educators and prevalence of training of educators, both in primary and secondary levels, significantly benefit human development in these countries.

The rest of the paper is organized as follows: section 2 reviews the relevant literature, section 3 describes methodology for the current empirical investigation, section 4 provides the results of our investigation and discussion, and finally concluding with section 5.

2. LITERATURE REVIEW

2.1 Going Beyond GDP : Multitude of Measures

If economic development is about raising the quantity and quality of goods and services available to human beings for a better life, people logically is the center of attention. Measuring development is then about changes in the quality of life. However, conventional measures of economic development, e.g., income per capita, aggregate productivity, etc., only crudely measure real condition of living and its change over a period (Miller & Wadsworth, 1967). The allure of a simple and objective parameter such as GDP is understandable but not defensible. GDP invariably provides a gross determination of a country's productive efforts over a period and can be used in a wide variety of circumstances– a feat which later, more inclusive measures have fallen short of achieving.

Despite simplicity, GDP (or any number of alternative measures of aggregate output for that matter) has been misused in understanding economic development for a long time (Costanza et al., 2009). Aggregate output measures were not meant for assessing inclusive human development. Unfortunately, these have been regarded as synonymous with human development in the recent past; much of the resultant conclusions from studies working with GDP as proxy for development are misleading, possibly to the detriment of society and ecology (Costanza et al., 2009, 2016). There is increasing consensus as to the inherent limitations of an aggregate output measure such as GDP in representing human and economic 'wellbeing'; the economic and development literature has amassed alternative measurement paradigms (Aitken, 2019; Fleurbaey, 2009).

It is important to understand that this shift in measurement focus is by no means the result of pure intellectual curiosity. Neither can this large-scale admission of the pressing need to go beyond GDP be attributed to academia alone. The hunt for alternative welfare paradigms emerged largely during the last two decades of the twentieth century when Earth's ecological balances were shaken by unprecedented human industrial activity (Dresner, 2008). The idea of economic progress with a provision for the rightful claims of future generations and for Earth's delicate and complex interdependent systems took center stage. Indeed, 'sustainability' has come a long way from a technical term referred to within ecological circles only, to becoming perhaps the dominant inclusive development paradigm today (Farrell & Hart, 1998; Scoones, 2007).

This ongoing endeavor in search of an ideal metric of human development can be expected to continue until at least some form of an interdisciplinary inventory is taken with regard to what counts as important welfare objectives.

Arguably, we may never reach a golden formula and instead have widespread recognition of the inherent subjectivity of the human condition. Human welfare, as a key outcome of public policy, may as well be best served by the perpetual development, modification, and fine-tuning of a multitude of measures that reflect diverse human experiences, aspirations as well as shifting economic and technological realities (Adams, 2006; Sen, 2001).

2.2 The Human Development Index (HDI)

Given this dilemma, one obstacle faced by empirical investigation of effective policy support for human development is the lack of consistent data. Longitudinal data on alternative human development metrices from across the globe are not easily available. Two major exceptions are: the Human Development Index (HDI) of United Nations Development Program (UNDP) and the Sustainable Development Index of the United Nations (with its constituent indicators and goal scores).

Since 1990, the UNDP has published country-specific scores on HDI in annual reports termed: Human Development Reports (HDRs). These publications, along with the HDI, have broadened the development policy debate and included a wider variety of measures to replace the ‘unidirectional’ gross domestic product (Sagar & Najam, 1998). The composite index, as of writing, is calculated as a “geometric mean of normalized indices for each of the three dimensions”: life expectancy, education, and gross national income (United Nations Development Programme [UNDP], 2024). Consistent data on composite index as well as the three constituent indicators are available for most countries around the world since 1990. Thus, apart from a major alternative measurement, the HDI is also one of the few consistently recorded indices of broader human welfare.

The index fails to consider any variable from the ecological domain, however. Recent HDRs have reportedly ‘stagnated’ in terms of regurgitating the same narrative without significant metric improvement (Sagar & Najam, 1998). There have been independent efforts to modify the metric (Lind, 2019; Noorbakhsh, 1998; Ranis, 2004).

There are other criticisms as well. It has been duly noted that HDI should be ‘handled with care’ as theoretical underpinnings for what constitutes a developed state of human condition per se are not firmly established (Kelley, 1991). HDI is sensitive to ‘plausible refinements’ in arbitrary targets in life expectancy, education, and economic status (Kelley, 1991), resulting in significant changes in country rankings when these parameters are adjusted even by justifiable degrees. These and similar lines of criticism often appear in the literature as justification to resort back to ‘simpler’ measures of aggregate output when designing and steering economic and development policy. However, that no longer seems adequate or viable.

2.3 Education for Sustainable Development

The role of education in overall economic and development discourse has also evolved considerably during the last century. Classical economic thought excludes education in modeling the role of investment and the idea of private investment for growth is limited to physical and financial resources. The change began with the understanding of education’s role in creating and fostering ‘human capital’ (Anikina et al., 2015; Weisbrod, 1962). Investment in future productivity through human capital formation, a key objective of institutional education, started to occur ‘increasingly outside the private market and in intangible forms' (Weisbrod, 1962). Traditional conception of investment as a 'private market phenomenon and only as tangible plant, machinery, and equipment' gave way to 'broader concept which allows not only for government investment but for intangible investment in the quality of human capital' (Weisbrod, 1962).

But this too has eventually been superseded with ideas proposed by the likes of Durkheim (1885) who had declared one and a half centuries earlier that the "aim of public education is not a matter of training workers for the factory or accountants for the warehouse but citizens for society". The moral grounds for education to be considered as the development of future enlightened citizens appear 'more defensible' compared to alternative motives (O'Flaherty & Liddy, 2018).

The conception of education as not just a productivity enhancement investment mechanism but rather, a deeply embedded channel for informing and integrating future generations around a common agenda of global sustainable development gained serious traction after the 1992 UN conference in Rio de Janeiro (The United Nations Conference on Environment and Development (UNCED), more commonly referred to as the 'Earth Summit').

The Education for Sustainable Development (ESD) movement sought to mobilize states, private sectors, institutions, and educators. UNESCO consequently observed 2005-2014 as the Decade of Education for Sustainable Development (DESD). Among the important findings of a report published at the end of DESD in 2014 were: education system's ability to address sustainability issues, the importance of multi-stakeholder collaboration for effective solutions, the instrumentality of political leadership in enabling ESD, and the need to integrate ESD in formal education and interactive pedagogies (UNESCO, 2014).

Indeed, a review of relevant literature shows that policy interventions have resulted in higher student awareness on global citizenship, greater appreciation for the challenges of climate change, and better understanding of the importance of sustainable development as a way forward (O'Flaherty & Liddy, 2018).

Studies have been undertaken to assess education's impact on economic and development outcome variables. Findings demonstrate the various channels of impact of education– through informed decision making abilities, improved health and life expectancy outcomes, improved gender parity status, wider awareness of national, regional, and global challenges, and a more acute understanding of the interdependencies of economic, social, and ecological systems (Jorgenson & Fraumeni, 1989; Lutz & KC, 2011; Pauw et al., 2015; UNESCO, 2014).

But empirical investigation of the educational system's direct impact on various conceptions of human development, particularly in cross-country settings, is limited (Binder & Georgiadis, 2010; Parvez et al., 2023).

2.4 The Need for Empirical Work on HDI in South Asia

Empirical investigation has been undertaken in single-country as well as cross-country studies to find the impact on HDI. These studies have chosen HDI as the human development outcome variable and used various hypothesized economic and non-economic factors. For example, Binder and Georgiadis (2010) looked at macroeconomic policy and comparative progress measured by GDP and HDI for 84 countries during the period 1970 to 2005. They found that macroeconomic policy affects GDP with far smaller delay than they affect HDI; the relationship with the latter being far less strong as well. The literature has a stream of what can be referred to as 'search for determinants' of development measured by HDI. Examples include inflation, per capital GDP, literacy, labor force participation, etc. as identified factors (Acar & Topdağ, 2022; Eren et al., 2014; Liu et al., 2021; Sari, 2022).

There are fundamental reasoning flaws in many of these determinant searches. First, studies in different countries have included within the determinants the very indicators that make up the composite HDI index. So, when a regression is estimated with HDI in the dependent variable and life expectancy in the predictor (along with other predictors), the results invariably show positive association. However, life expectancy itself is determined by economic, health, and social factors. Second, without underlying theoretical grounds, these determinant searches only provide empirical validation for the direction and strength of certain variables with the composite HDI index. Proposing and defending policy interventions based on these findings are difficult.

More importantly, effects of climate change and geopolitical changes are deemed priority agenda for South Asian emerging economies. Large-scale investments are needed across sectors like transportation, education, and disaster management in the coming years (Lohani, 2009). Judicious resource allocation in these countries, including Bangladesh, will determine the quality of human lives. Cross-country empirical analysis of investment in education within the South Asian region, and Bangladesh in particular, is inadequate. This may hinder policy decisions to enable ESD at a time when climate change pushes these economies towards severe adaptation challenges.

Hence, an empirical analysis of the relationship between the education system and human development in the recent past within South Asian economies is necessary to provide justification for future investments in education.

As a country facing some of the worst predictions of climate change impact (Delaporte & Maurel, 2018) and large and young population waiting to be utilized for 'demographic dividend' (Bloom et al., 2003), informed policy decisions in the education sector for sustainable development is even more critical for continued prosperity for Bangladesh.

3. METHODOLOGY

3.1 Data

Empirical evidence of investment in education contributing to human development for South Asian countries is sparse in the literature. In this paper, we provide cross-country evidence to characterize education's impact on human development in ten South Asian nations with similar economic and social realities. Table 1 provides a list of the countries selected for the study, along with their income group and GNI (Gross National Income) per capita, as per data from World Bank (WB). This selection is not based on any rigid criteria. All have economic, social, and demographic challenges similar to Bangladesh. Moreover, Bangladesh maintains active trade relations with these economies. Almost all have significant and rising populations, and face varying levels of ecological and economic threats from climate change. There is considerable variation, however, in governance across these countries.

Table 1 : List of Countries included in the Panel

Code	Country	2022 WB Income Group[a]	2022 WB Atlas GNI Per Capita[b]
BGD	Bangladesh	Lower-middle income	$2,820
KHM	Cambodia	Lower-middle income	$1,690
IND	India	Lower-middle income	$2,390
IDN	Indonesia	Upper-middle income	$4,580
MYS	Malaysia	Upper-middle income	$11,830
NPL	Nepal	Lower-middle income	$1,340
PHL	Philippines	Lower-middle income	$3,950
LKA	Sri Lanka	Lower-middle income	$3,610
THA	Thailand	Upper-middle income	$7,230
VNM	Vietnam	Lower-middle income	$4,010

Country-level annual data are collected for a period of 32 years from 1991 to 2022 from United Nations Development Program's (UNDP) Human Development Reports (HDR) dataset and the World Bank's Wold Development Indicators (WDI) dataset. The only exception of time period is the governance control variable taken from Worldwide Governance Indicators (WGI), published by the World Bank. Data for WGI are available for 1996-2022.

With 10 series, 10 cross-sections, and 32 annual time-periods, our panel data is 'long' and strongly balanced. For analysis and modelling purposes, Stata/MP version 13.0 is deployed. The Stata code for the current analysis is provided in Appendix 1. Our dataset is available upon request for reviewers and interested researchers.

a In FY2023, Atlas GNI per capita thresholds for income classification was: Low income (<=1,085), Lower-middle income (1,086 to 4,255), Upper-middle income (4,256 to 13,205), and High income (13,205). On July 2023, these thresholds have been slightly adjusted for FY2024 as part of a routine process to account for the effect of inflation.

b The World Bank Atlas method for GNI adjusts for effects of exchange rate fluctuations and inflation. Local currency GNI divided by mid-year population is converted to USD using the average of current year exchange rate and two preceding years. Inflation adjustment is done through "weighted average of GDP deflators" of United States, United Kingdom, Euro Area, Japan, and China.

Dependent Variable

This paper measures human development with UNDP's Human Development Index (HDI). HDI is calculated as geometric mean of scores on three dimensions: health, education, and income. Life expectancy at birth constitutes health dimension. Income is measured with GNI per capita, measured in international purchasing power parity (PPP) dollar amount from 2010 onwards.

Two separate measures constitute the education dimension; average years of schooling for adults (25+ years) and expected average years of schooling for children of entering age (UNDP, 2024). Annual country level measurements on each of the four indicators are normalized to calculate the three index scores. The geometric mean of the three indices are then taken as composite HDI, given by the following equation:

$$HDI = \sqrt[3]{LEI \cdot EI \cdot II} \qquad (1)$$

where, LEI= Life Expectancy Index; EI= Education Index; and II= Income Index.

Normalization of indicator score for each country is performed based on expected higher and lower bounds. Table 2 lists the indices and formulas. It can be noted that to score 1 or 0 in the life expectancy index, a country needs life expectancy in years of 85 or 20 respectively. Average and expected years of schooling are set at 15 years for mean years of schooling index (MYSI) and 18 years for expected years of schooling index (EYSI). Per capita GNI of US$75,000 in international PPP scores a country as 1 on the income index and US$ 100 scores as 0.

Table 2 : HDI Index and Calculation Formula

Index	Index Score Formula	Description
Life Expectancy Index (LEI)	$LEI = \frac{LE - 20}{85 - 20}$	Country scores 1 if average life expectancy in years is 85 and 0 if 20.
Education Index (EI)	$EI = \frac{MYSI + EYSI}{2}$	Mean Years of Schooling Index is calculated as: $MYSI = \frac{Mean\ years\ of\ schooling}{15}$ Expected Years of Schooling Index is calculated as: $EYSI = \frac{Expected\ years\ of\ schooling}{18}$
Income Index (II)	$II = \frac{ln(GNIpc) - ln(100)}{ln(75{,}000) - ln(100)}$	Countries score 1 if GNI per capita (PPP) is US$75,000 and 0 if GNI per capita (PPP) is US$100

Source : UNDP

Independent Variable

This paper takes two alternative approaches in defining the predictor for the regression model. First, total government expenditure on education as a percentage of GDP (variable code: EDEX) is taken as the direct measure of investment in education.

We also argue that higher investment in education will be reflected in higher number of teachers and higher prevalence of training among these educators at different levels of institutional education system. Primary and secondary education levels are deemed most important within the institutional education framework. In our second approach, we, therefore, look at the total number of teachers in primary and secondary levels (variable codes: NPET and NSET respectively). We also look at the percentage of trained teachers in the primary and secondary levels (variable codes: TPET and TSET respectively).

Control Variables

The ten countries selected for the current empirical investigation constitute a group of upper- and lower-middle income economies, commonly attributable as peers for Bangladesh. For statistical purposes, however, there is considerable variation in their respective economics, demographics, and institutions. Properly capturing the true impact of education on HDI requires a selection of control variables. This paper deploys four of these control variables. GDP per capita (variable code: GDPC) and exports as a percentage of GDP (variable code: EXPT) account for size and foreign trade dynamics of the countries.

Regulatory quality (variable code: RQLT) is a proxy measure constructed by the World Bank that quantifies “perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development”. This is done in units of the standard normal distribution (Kaufmann & Kraay, 2023). Data are collected through 30 WB-affiliated think tanks and research organizations on the basis that they provide credible, comparable, and regular estimates.

Finally, population density (variable code: DNST) captures the variation in population density among the countries and its resultant impact on human development challenges and opportunities. The impact of density on human development has been documented in Bille et al. (2023), for example. Densely populated urban areas offer greater economic opportunities while deteriorating urban ecological balance, thereby presenting an interesting case of complicated relation with human development.

Similarly, the impact of GDP and international trade on human development has been examined across countries with varying degrees of relationship (Afzal et al., 2009; Elistia & Syahzuni, 2018; Gökmen & Turen, 2013). Institutional quality mediates the effect of other factors on human development. As such, governance and cultural forces play a pivotal role in determining wellbeing (see Tridico (2007), for example). Table 3 provides a full list of variables and their descriptions and sources.

Table 3 : List of Variables, Description, and Data Source

Sl. No.	Variable Code	Description	Source
Dependent variable			
1	HDI	Human Development Index composite score	HDI, UNDP
Investment in education			
2	EDEX	Total expenditure on education as a percentage of GDP	WDI, WB
Number of educators and training variables			
3	NPET	Number of primary school teachers	WDI, WB
4	NSET	Number of secondary school teachers	WDI, WB
5	TPET	Percentage of primary teachers who are trained	WDI, WB
6	TSET	Percentage of secondary teachers who are trained	WDI, WB
Control variables			
7	GDPC	Per capita GDP at constant 2015 US dollar	WDI, WB
8	RQLT	Regulatory quality	WGI, WB
9	EXPT	Total exports of goods and services as a percentage of GDP	WDI, WB
10	DNST	Population density	WDI, WB

Note : All variables are country-level annual data for 1991-2022, except RQLT which is for 1996-2022
HDI stands for Human Development Index
UNDP stands for United Nations Development Program
WB stands for World Bank
WDI stands for World Development Indicators
WGI stands for Worldwide Governance Indicators

3.2 Empirical Model

In order to investigate education's impact on human development, we model cross-country longitudinal data using fixed effect panel regression model with control variables. In any longitudinal dataset, estimations may be inaccurate if there are unobserved heterogeneity– meaning variation arising from the group-level factors fixed over time. This unobserved, time-invariant heterogeneity is accounted for in a fixed effect model by allowing for group-specific intercepts (Wooldridge, 2012). Equation (2) shows a generic fixed effect model where the dependent variable Y_{it} (for country *i* at year *t*) is regressed against *k* number of predictors X_{it} (for country *i* at year *t*), each with a time-invariant β coefficient. The intercept, α_i, is not fixed and varies across groups.

$$Y_{it} = \alpha_i + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \cdots + \beta k X_{k,it} + \epsilon_{it} \tag{2}$$

Econometricians often use the random effects model for better estimations. This is definitely the case in certain scenarios. But there are caveats as to when a random effects model is appropriate (Dougherty, 2011). Equation (3) below gives a generic random effects model, the important differences with fixed effects model being: a) the constant intercept term, α_0, for the regression, and b) the composite error term, $(\mu_i + \epsilon_{it})$.

$$Y_{it} = \alpha_0 + \beta_1 X_{1,it} + \beta_2 X_{2,it} + \cdots + \beta_k X_{k,it} + (\mu_i + \epsilon_{it}) \quad (3)$$

It is difficult to ascertain when the random effect or the fixed effect model is more appropriate. If there are reasons to believe that group specific heterogeneity is present, fixed effects model is undoubtedly necessary. A pooled ordinary least squares (OLS) model, which can be thought of as the panel data counterpart for the ordinary least squares regression, is ineffective here. Yet random effects model, in certain cases, does this job better.

The conventional approach is to estimate both a fixed effect and a random effect model and compare the two resulting estimations. More precisely, the Durbin-Wu-Hausman test is conducted to compare estimates for any statistically significant difference.

The prerequisite assumption of random effects is that the intercept terms α_i are uncorrelated with the β coefficients. Hence, the null hypothesis of the Durbin-Wu-Hausman test of no difference between estimates cannot be rejected when the relationship between α_i and β coefficients are not strong (Dougherty, 2011; Wooldridge, 2012). In that case, a random effect model is generally deployed.

There is one major flaw with this approach. The assumption that the intercept terms are uncorrelated with the β coefficients is hardly ever true. In our case, for example, that would mean that all country-specific factors that influence HDI other than expenditure on education are also not correlated with GDP per capita. Unless there are strong theoretical reasons to maintain the uncorrelation assumption, estimating a random effects model simply based on the Durbin-Wu-Hausman test statistic is not an effective way to investigate the underlying relationship. In our case, this is definitely the case.

We cannot conceive a large number of country-specific time invariant factors, other than education and control variables that affect HDI, to not be correlated with the education and control variables included as well.

For the aforementioned reasons, for our current empirical investigation, we estimate a fixed effect panel regression (of the generic form given by Equation (2)). Equation (3) below provides the model with all the controls:

$$HDI_{it} = \alpha_i + \beta_1 EDU_{it} + \beta_2 GDPC_{it} + \beta_3 RQLT_{it} + \beta_4 EXPT_{it} + \beta_5 DNST_{it} + \epsilon_{it} \quad (4)$$

where, HDI_{it} is the HDI index of country *i* at year *t*; a_i is the intercept term for country *i*; EDU_{it} is the education related predictor variable for country *i* at year *t*; and β_1

is the coefficient of that variable. The control variables per capita GDP, regulatory quality, exports, and population density for country i at year t are given by $GDPC_{it}$, $RQLT_{it}$, $EXPT_{it}$, $DNST_{it}$ respectively along with their coefficients β_2, β_3, β_4, and β_5 respectively. The random error term is ϵ_{it}.

One assumption of a regression equation is the randomness of the error term. Variation in the dependent variable that are not modelled must be random for the estimations to be unbiased. This is hardly ever case with a fixed effect model. Since there are country-specific factors going into the dependent variable, part of the data generation process that is not modelled must also be shared within that country group.

This causes error terms within groups to be correlated, making the standard errors inaccurate. The 'robust' way to get around this problem is through using clustered standard errors. More precisely, by using standard errors that are clustered at the fixed effect level- in our case, standard errors clustered by country. Thus, in this paper, we use clustered standard errors in all the models estimated.

4. RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Descriptive statistics of variables used in this empirical work are listed in Table 4. All 320 observations for the dependent variable, HDI, are available. However, there are missing values of varying proportion in other variables. This is due to unavailability of a particular country-year observation in the compiled World Bank dataset. This happens generally because of difficulty in obtaining the observation from national statistics or absence of reliable alternative estimates. Our panel data is overall strongly balanced for Stata analysis and modelling purposes.

Table 4 : Descriptive Statistics of Study Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
HDI	320	0.62	0.107	0.384	0.807
EDEX (%)	228	3.239	1.191	0.999	7.658
GDPC ($)	318	2,575.743	2,283.359	353.957	11,399.397
RQLT	240	-0.265	0.444	-1.176	0.799
EXPT (%)	313	39.644	26.477	5.119	121.311
DNST (per 1,000 per km sq)	310	293.712	286.361	52.455	1,301.039
NPET	260	580,707.68	913,731.52	37,616	4,656,045
NSET	187	716,246.37	1,242,974.2	17,971	6,678,915
TPET (%)	128	87.844	20.328	14.682	100
TSET (%)	69	87.186	14.791	38.305	100

First, we note that mean HDI score during 1991-2022 for the ten countries included in the paper is 0.62. HDI scores exhibit a standard deviation of 0.107. Across ten countries and 32 years, HDI scores range from 0.384 to 0.807. Country-wise boxplot of HDI scores is given in Figure 2 below. Our primary predictor variable, total government expenditure on education as a % of GDP, has a mean value of 3.323 during the study period. For context, average Organisation for Economic Co-operation and Development (OECD) government expenditure on education for 2021 was 11.1% of GDP. The global average was 12.7%. The ten Asian countries included in the study thus under-allocates on education during 1991-2022 by several orders of magnitude.

Among control variables, we note that mean per capita GDP in the ten countries is $2,576 (in constant 2015 USD), but the standard deviation is high at $2,283. Mean regulatory quality, as measured by the World Bank perception variable, is -0.265, and the variable ranged from -1.176 to +0.799. Mean population density per thousand km/sq. is 293 people with a range of 52 people to 1,301 people.

Apart from education expenditure, we also look at the number and training of teachers in primary and secondary levels. Considerable variation is detected in number of teachers engaged in the two levels. Approximately, 580,000 teachers in the primary levels and 716,000 teachers in the secondary levels are engaged on average across the ten countries. Maximum number of teachers in the primary and secondary levels are around 4.6 and 6.6 million respectively. Finally, 88% and 87% of teachers in the primary and secondary levels respectively are trained on average during the study period. In some countries in our longitudinal dataset, these are as low as 15 percent and 38 percent respectively. Maximum values for both were 100 percent– in countries where all primary and secondary teachers are trained.

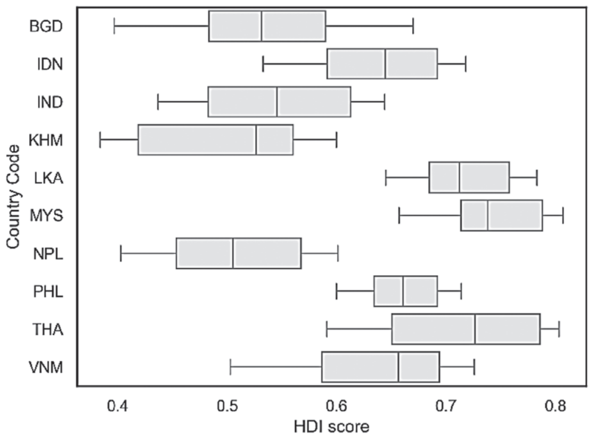

Figure 2 : Boxplots of HDI Scores for Countries included in the Panel during 1991-2022

Source : Plotted by the Authors using UNDP Data

The only apparent abnormality in Table 4 is the range for EXPT, the variable that measures total exports of goods and services as a percentage of GDP. We note that this ranges from 5.119% to 121.311%. As exports is one of the components that make up gross domestic product, it is unusual for exports to be greater than 100% of GDP. However, after looking at the dataset closely, we find the explanation.

Greater-than-hundred percent export figures were in Malaysia in several years from 1998 to 2007. The reason for these unusual numbers lies in how the World Bank calculates total exports and total GDP in USD. Local currency GDP is converted to USD using current year average of exchange rates of the local currency with the USD. In case where the exchange rate fluctuates abruptly for any number of financial or macroeconomic circumstances and the official exchange rate deviates largely from the effective rate, an "alternative conversion factor is used" (World Bank, 2023). This affects the GDP figure but not the exports figure since national GDP estimates have to be converted back to USD using an exchange rate. Indeed, the Malaysian ringgit exhibited volatility around 1998 and 2007.

Incidentally, Malaysia is not the only nation in the World Bank dataset where exports exhibit this unusual ratio. Outside our panel, Hong Kong's exports, for example, as a percentage of GDP in 2022 is 193.9 percent. The Malaysian figures do not pose any difficulty for the current modeling purpose since all other countries are compared using the same metric.

4.2 Correlations

Table 5 shows the correlation matrix. HDI score shows a positive correlation coefficient of 0.319 with education expenditure, 0.860 with per capita GDP, 0.799 with regulatory quality, 0.572 with exports, and -0.572 with population density. Although it shows here a negative coefficient with number of teachers in primary and secondary levels, these are close to 0. Coefficient values of 0.324 and 0.487 are found for the training of teachers in primary and secondary levels respectively.

Interestingly, we observe that the proxy variable measuring regulatory quality perception has a -0.420 correlation with population density. This confirms common understanding that institutional quality in densely populated nations in the South Asian region is difficult to manage. In general, density shows negative correlation coefficient with most other variables included in the study.

Table 5 : Correlation Matrix of Study Variables

Variables	HDI	EDEX	GDPC	RQLT	EXPT	DNST	NPET	NSET	TPET	TSET
HDI	1.000									
EDEX	0.319	1.000								
GDPC	0.860	0.521	1.000							
RQLT	0.799	0.564	0.901	1.000						
EXPT	0.572	0.439	0.779	0.770	1.000					

Table 5 (Contd.)

Variables	HDI	EDEX	GDPC	RQLT	EXPT	DNST	NPET	NSET	TPET	TSET
DNST	-0.249	-0.421	-0.411	-0.420	-0.487	1.000				
NPET	-0.085	0.187	-0.143	0.028	-0.151	0.244	1.000			
NSET	-0.089	0.170	-0.141	0.018	-0.148	0.211	0.995	1.000		
TPET	0.324	0.346	0.335	0.450	0.360	-0.794	-0.155	-0.157	1.000	
TSET	0.487	0.319	0.470	0.651	0.601	-0.610	-0.055	-0.073	0.864	1.000

4.3 Panel Model Findings

We present our panel model estimations in two separate tables: Table 6 shows estimations with education expenditure as the predictor while Table 7 shows estimations with the 4 educator related variables as predictors.

Model (1) in Table 6 includes per capita GDP as the only control variable. Model (2) includes per capita GDP and regulation quality. Model (3) includes per capita GDP, regulation quality, and exports. Finally, Model (4) includes all four controls including population density. All four models use standard errors clustered at the country level and deploy country fixed effects. Table 6 also lists the adjusted R-squared values.

We start by noting that all four models exhibit F-statistics (12.07, 8.09, 12.85, 55.42 respectively) that are significant at the 1% level. However, the dramatic jump in the F-static from 12.85 to 55.42 in Model (4) after including population density as additional control variable should be underlined. Density seems to play a big role across our analyses in determining human development outcomes.

More importantly, from Table 6, we find that coefficients for EDEX are positive and significant at the 1% level in Models (1), (2), and (3), and at the 5% level for Model (4). This provides strong statistical evidence of aggregate expenditure on education positively affecting human development in the ten countries during 1991-2022. Countries that spent higher on education experienced greater improvements in human development as quantified by HDI. Specifically, as per Model (4), a 1 percentage point increase in government expenditure in education– measured as % of GDP– is associated with 0.01515 increase in HDI. In interpreting this number, we have to note that the HDI scale is from 0 to 1. Therefore, an increase of 10 percentage points can take a country 0.1515 points ahead in the HDI scale– a substantial improvement by any account.

Among controls, per capita GDP, exports, and density have positive coefficients, and regulatory quality has negative coefficient. Coefficients for GDPC and DNST are significant at the 1% level. Exports coefficient is significant at the 10% level. The coefficient for regulatory quality, RQLT, in Models (2), (3), and (4) are all negative but not significant.

Table 6 : Panel Model Estimations with Expenditure on Education as Predictor Variable

Variables	(1)	(2)	(3)	(4)
EDEX	0.01972***	0.02004***	0.02112***	0.01515**
	(0.00462)	(0.00570)	(0.00542)	(0.00536)
GDPC	0.00005***	0.00005***	0.00005***	0.00004***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
RQLT		-0.04499	-0.04183	-0.04726
		(0.02984)	(0.02993)	(0.03364)
EXPT			0.00112**	0.00093*
			(0.00047)	(0.00044)
DNST				0.00049***
				(0.00008)
Constant	0.44332***	0.43159***	0.36081***	0.27167***
	(0.04254)	(0.04566)	(0.04147)	(0.04615)
Observations	228	193	188	181
R-squared	0.612	0.624	0.667	0.802
Clusters	10	10	10	10
Country FE	Yes	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes	Yes

Note : Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
The dependent variable is country-specific HDI score
Data are in annual interval for 1991-2022

We turn our attention to Table 7. The predictor in Model (5) is number of teachers at the primary level and in Model (6), the predictor is number of teachers at the secondary level. Model (7) runs the estimation with proportion of trained teachers in primary level as the predictor. Model (8) runs this for the secondary level.

First, F-statistics (25.79, 54.54, 3,872.97, 177.17) for all four models are significant at the 1% level. The F-statistic for Model (7) is exceptionally high, indicating possible strong explanatory power of prevalence of training of primary level educators. The importance of primary school enrollment in overall human development is well documented in the literature (see Petrosino et al. (2012) for a systematic review). But sparse evidence can be seen when it comes to training of educators in primary schools. Indeed, our findings provide further empirical support for the development of primary school educators.

Table 7 : Panel Model Estimations with Educator Variables as Predictors

Variables	(5)	(6)	(7)	(8)
NPET	0.00000**			
	(0.00000)			
NSET		0.00000***		
		(0.00000)		
TPET			0.00091***	
			(0.00011)	
TSET				0.00119***
				(0.00028)
GDPC	0.00003***	0.00003**	0.00003***	0.00002*
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
RQLT	-0.04222	-0.03240	-0.05558	-0.06413
	(0.03375)	(0.04000)	(0.03232)	(0.03516)
EXPT	0.00087**	0.00057	0.00056*	-0.00021
	(0.00038)	(0.00085)	(0.00028)	(0.00056)
DNST	0.00051***	0.00050***	0.00068***	0.00055***
	(0.00015)	(0.00009)	(0.00009)	(0.00007)
Constant	0.33783***	0.33862***	0.26164***	0.32659***
	(0.03911)	(0.05203)	(0.04647)	(0.07998)
Observations	189	134	113	61
R-squared	0.78876	0.77651	0.85731	0.80057
Clusters	10	10	9	8
Country FE	Yes	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes	Yes

Note : Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
The dependent variable is country-specific HDI score
Data are in annual interval for 1991-2022

We note that coefficients for all of these 4 models are positive and statistically significant. For Models (6), (7), and (8), they are significant at the 1% level. For Model (5), the significance is at the 5% level. Understandably, the coefficients in Model (5) and (6) themselves are very small. Outputs in this table are accurate 5 points after the decimal. But the absolute values of the coefficients are not zero[c].

The close to zero values are sensible given that teacher numbers are measured in absolute headcounts. To interpret, we can multiply by a million. Hence, our findings

c The coefficients are 3.90×10^(-08) for NPET and 1.51×10^(-08) for NSET show that a one million increase in number of primary school teachers in the ten countries during the study period is associated with an increase of HDI of 0.039, which is significant considering HDI is on a 0 to 1 scale. For secondary school teachers, this increase is 0.015, again significant but not as strong.

Regarding proportion of teachers trained: a 1 percentage (or 10 percentage) point increase in proportion of trained teachers in primary schools is associated with 0.00091 (or 0.0091) increase in HDI scores. In the secondary level, a 1 percentage (or 10 percentage) point increase in proportion of trained teachers is associated with 0.00119 (or 0.0119) increase in HDI scores. Thus, in case of training, our findings show greater impact in secondary education compared to primary.

5. CONCLUSION

As countries across the world prepare to face new challenges from economic and environmental fronts, the utility of simplistic measures such as GDP is brought under serious scrutiny. Within the context of ongoing search for better measures of human welfare, this paper takes a look into Human Development Index for ten countries in South Asia, including Bangladesh. The importance of education for sustainable development has been propagated for nearly two decades now. But cross-country empirical evidence of education's impact on human development has not been adequately explored. Particularly, for emerging economies with large and young populations– of which Bangladesh is an ideal example– education plays a crucial role in fostering or hindering prosperity.

In this paper, we deploy panel data regression analysis to characterize the impact of education on human development– as measured by UNDP's HDI. For all its criticisms, HDI is still an improvement from unidirectional aggregate output measures like GDP. Hence, for sustainable economic development, HDI is a relevant metric. We show that indeed government expenditure on education is associated with significant improvements in HDI scores in countries during the period 1991-2022. Additionally, number of educators in primary and secondary levels is positively associated. Similar association is found in case of proportion of trained educators as a percentage of total educators in primary and secondary levels.

Together, our results provide strong and statistically robust evidence of education's positive impact on human development progress in the selected south Asian countries– particularly primary and secondary education. Our findings are in line with similar studies in the literature (Anikina et al., 2015; Riana & Khafid, 2022; Sari, 2022). We hope such empirical evidence will inform future development and education policy decisions as these economies navigate new challenges in the coming decades and pave the way for a sustainable development. Future researchers can explore other parameters of educational investment and inclusive human development for further consolidation of this line of investigation.

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APPENDIX

```
// clear previous data
clear
// assign working directory to an existing folder
cd "C:\Stata Results\"
// import merged dataset in .csv format (note: edit according to file location)
import delimited "C:\Data\ KM_ Data_Mar2024", varnames(1) case(preserve)
// generate numeric country code and set panel data
egen CountryNum = group(CountryCode)
xtset CountryNum Year, yearly
// predictor: current education expenditure as a % of gdp
xtreg HDI SE_XPD_TOTL_GD_ZS NY_GDP_PCAP_KD, fe cluster(CountryNum)
xtreg HDI SE_XPD_TOTL_GD_ZS NY_GDP_PCAP_KD RQ_EST, fe
cluster(CountryNum)
xtreg HDI SE_XPD_TOTL_GD_ZS NY_GDP_PCAP_KD RQ_EST NE_EXP_
GNFS_ZS, fe cluster(CountryNum)
xtreg HDI SE_XPD_TOTL_GD_ZS NY_GDP_PCAP_KD RQ_EST NE_EXP_
GNFS_ZS EN_POP_DNST, fe cluster(CountryNum)
// predictor: number and training of teacher in primary and secondary
xtreg HDI SE_PRM_TCHR NY_GDP_PCAP_KD RQ_EST NE_EXP_GNFS_ZS
EN_POP_DNST, fe cluster(CountryNum)
xtreg HDI SE_SEC_TCHR NY_GDP_PCAP_KD RQ_EST NE_EXP_GNFS_ZS
EN_POP_DNST, fe cluster(CountryNum)
xtreg HDI SE_PRM_TCAQ_ZS NY_GDP_PCAP_KD RQ_EST NE_EXP_
GNFS_ZS EN_POP_DNST, fe cluster(CountryNum)
xtreg HDI SE_SEC_TCAQ_ZS NY_GDP_PCAP_KD RQ_EST NE_EXP_
GNFS_ZS EN_POP_DNST, fe cluster(CountryNum)
```

Note:

Code	Series Name
HDI	Human Development Index composite score
SE_XPD_TOTL_GD_ZS	Total expenditure on education as a percentage of GDP
SE_PRM_TCHR	Number of primary school teachers
SE_SEC_TCHR	Number of secondary school teachers
SE_PRM_TCAQ_ZS	Percentage of primary teachers who are trained
SE_SEC_TCAQ_ZS	Percentage of secondary teahers who are trained
NY_GDP_PCAP_KD	Per capita GDP at constant 2015 US dollar
RQ_EST	Regulatory quality
NE_EXP_GNFS_ZS	Total exports as a percentage of GDP
EN_POP_DNST	Population density